

PCT

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PD030123	FOR FURTHER ACTION	
	See Form PCT/IPEA/416	
International application No. PCT/EP2004/010221	International filing date (day/month/year) 13.09.2004	Priority date (day/month/year) 11.12.2003
International Patent Classification (IPC) or national classification and IPC G11B20/00, H04H1/00		
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1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

3. This report is also accompanied by ANNEXES, comprising:

- (*sent to the applicant and to the International Bureau*) a total of 8 sheets, as follows:
 - sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
- (*sent to the International Bureau only*) a total of (indicate type and number of electronic carrier(s)), containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

Date of submission of the demand 07.10.2005	Date of completion of this report 11.11.2005
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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
 - international search (under Rules 12.3 and 23.1(b))
 - publication of the international application (under Rule 12.4)
 - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

Description, Pages

1-15 as originally filed

Claims, Numbers

1-9 filed with telefax on 07.10.2005

Drawings, Sheets

1/2, 2/2 as originally filed

a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. The amendments have resulted in the cancellation of:
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):
4. This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - the description, pages
 - the claims, Nos.
 - the drawings, sheets/figs
 - the sequence listing (*specify*):
 - any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-9
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-9
Industrial applicability (IA)	Yes:	Claims	1-9
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following documents:

D1 = US-A-2003/0169804

D2 = US-A-5 319735

D3 = EP-A-0 366 381

D4 = LOBOGUERRERO: 'Iterative Informed Audio Data Hiding Scheme Using Optimal Filter' ICCT 2003, vol. 2, 9 - 11 April 2003, pages 1408-1411, XP009029945 Beijing

2. The subject-matter of claim 1 lacks an inventive step with respect to the combination of the disclosures of documents D1 and D2. Therefore, claim 1 does not meet the requirements of Article 33(3) PCT.

Document D1 discloses a method for transmitting watermark data bits comprising the steps of:

amplitude or phase modulating the code ([0031] "Amplitude or phase modulation of the code signals can be employed");

determining whether at one or more different candidate frequency band positions in a current frame of said audio signal the energy or amplitude level of said audio signal is such that it can mask or more of said modulated frequencies ([0021] "The band with the maximum energy content is found. This process up to here can use part of the psycho-acoustic modelling performed by an MPEG encoder.") and notch filtering said audio signal at the corresponding frequency band positions ([0021] "The notch frequencies are placed in one of the two neighbouring bands") and inserting the

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carrier frequencies at said positions (step b of claim 1 "inserting a code signal into said multi-frequency signal in the said one or more frequency ranges");

transmitting data telling the decoder where notches are going to be inserted ([0031]) This implies that the notches are determined ahead in time to provide said data for transmission);

transmitting the watermarked audio signal ([0031] "data telling the decoder where notches are going to be inserted ... can be sent via different channel" implies that the watermarked audio signal is transmitted on a first channel).

The subject-matter of claim 1 differs from the disclosure of Document D1 in that the former further specifies modulating the watermark data bits on an encoder pseudo-noise sequence, and that the watermark signal carrier is transmitted in different frequency bands for successive frames to decrease watermark data bit errors caused by echoes.

However, the advantages of spread spectrum modulation of watermarks are well known in the art (see, for instance, Document D2). Therefore, the skilled person would inevitably try to apply spread spectrum modulation to the codes before modulating them onto a carrier.

Both Document D1 (paragraphs [003], [0024] and [0025]) and Document D3 disclose varying the position of the notches to reduce the detectability of the watermark. It is clear to the skilled person that this variation also reduces the interference between watermarks in successive frames.

Thus, the subject-matter of claim 1 is rendered obvious by the disclosures of documents D1, D2 and D3.

3. The subject-matter of claim 2 lacks an inventive step with respect to the combination of the disclosures of documents D2 and D3. Therefore, claim 2 does not meet the requirements of Article 33(3) PCT.

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Document D3 discloses a method for transmitting watermark data bits comprising te steps of notch filtering the audio signal at frequency band positions which are arranged in a predefined pattern across the sequence of frames of said audio signal (figure 1 pairs A, B or C) and inserting the code signals in said notches.

The subject-matter of claim 2 differs from the disclosure of Document D3 in that the former further specifies modulating the watermark data bits on an encoder pseudo-noise sequence.

However, the advantages spread spectrum modulation of watermarks are well known in the art (see, for instance, Document D2). The skilled person would inevitably try to apply spread spectrum modulation to the codes before modulating them onto a carrier.

For the variation of the notches, reference is made to the objections raised against claim 1.

Thus, the subject-matter of claim 2 is rendered obvious by the disclosures of documents D2 and D3.

4. The subject-matter of claim 3 lacks an inventive step with respect to the combination of the disclosures of documents D1, D3 and D4. Therefore, claim 3 does not meet the requirements of Article 33(3) PCT.

Document D4 discloses (see page 1409 "2) Optimal detection") a method for regaining watermark data bits embedded in a spread spectrum comprising the steps of convolving the current frame of the received signal with the matched filter to the spreading code signal $C(t)$, sampling the convolution every T seconds in a synchronized way, and determining from the sign of the peaks of the convolution result the value of a bit of said watermark data (see formula (4)).

The subject-matter of claim 3 differs from the disclosure of Document D4 in that the former further specifies demodulating the signals on the carrier frequencies using the

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transmitted information.

However, this feature is known from Document D1, paragraph [0033]. As pointed out with respect to claim 1, the skilled person would inevitably try to combine the notch filtering known from Document D1 with spread spectrum modulation of the watermark code bits. Therefore, it would be obvious to combine the demodulation from Document D1 with the detection of Document D4.

For the variation of the notches, reference is made to the objections raised against claim 1.

Thus, the subject-matter of claim 3 is rendered obvious by the disclosure of Documents D1, D3 and D4.

5. The subject-matter of claim 4 lacks an inventive step with respect to the combination of the disclosures of Documents D3 and D4. Therefore, claim 4 does not meet the requirements of Article 33(3) PCT.

Document D4 discloses (see page 1409 "2) Optimal detection") a method for regaining watermark data bits embedded in a spread spectrum comprising the steps of convolving the current frame of the received signal with the matched filter to the spreading code signal C(t), sampling the convolution every T seconds in a synchronized way, and determining from the sign of the peaks of the convolution result the value of a bit of said watermark data (see formula (4)).

The subject-matter of claim 4 differs from the disclosure of Document D4 in that the former further specifies demodulating the signals on the predefined carrier frequencies.

As pointed out with respect to claim 1, the skilled person would inevitably try to combine the notch filtering known from Document D3 with spread spectrum modulation of the watermark code bits. Therefore, it would be obvious to demodulate the signals before detecting the codes in accordance with Document D4.

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For the variation of the notches, reference is made to the objections raised against claim 1.

6. The subject-matter of claims 5 to 8 lacks an inventive step with respect to the disclosure of the cited prior art. Therefore, claims 5 to 8 do not meet the requirements of Article 33(3) PCT.

Claims 5 to 8 specify apparatus features corresponding to the method steps of claims 1 to 4, respectively. Therefore, claims 5 to 8 are objected to for the reasons set out above.

7. The subject-matter of claim 9 lacks an inventive step with respect to the cited prior art. Therefore, claim 9 does not meet the requirements of Article 33(3) PCT.

Claim 9 further specifies an obvious feature of psycho-acoustic masking.

Claims

1. Method for transmitting watermark data bits (IWATD) using a spread spectrum, said method including the steps:
 - 5 - modulating (BVMOD) said watermark data bits on an encoder pseudo-noise sequence (ENCPNSEQ);
 - modulating (FCMOD) said modulated encoder pseudo-noise sequence (WATS) on a carrier frequency (f_{ci});
 - determining (WATSEF) whether at one or more different
- 10 candidate frequency band positions in a current frame of said audio signal the energy or amplitude level of said audio signal is such that it can mask one or more, respectively, of said modulated carrier frequencies (f_{ci}) and, if this is true, notch filtering (WATSEF) said audio signal at the corresponding frequency band positions and inserting (WATSEF) at this frequency or at each of these frequencies, respectively, said carrier frequency or one of said carrier frequencies, respectively;
- 15 - checking (WATSEF) at which candidate frequency band positions in a frame following said current frame of said audio signal the energy or amplitude level of said audio signal is such that it can mask one or more, respectively, of said modulated carrier frequencies (f_{ci}), and providing information about the locations of these frequency band positions;
- 20 - transmitting or transferring (TRM) data of said current audio signal frame carrying said watermark data bits together with the information about the locations of the frequency band positions to be used in said frame following said current frame of said audio signal,
- 25 wherein, in the frame following said following frame, no watermark signal carrier is transmitted in the frequency band or bands which have been occupied in said current frame, in order to decrease watermark data bit errors
- 30 caused by echoes following reception of said audio signal.

2. Method for transmitting watermark data bits (IWATD) using a spread spectrum, said method including the steps:

- modulating (BVMOD) said watermark data bits on an encoder pseudo-noise sequence (ENCPNSEQ);

5 - modulating (FCMOD) said modulated encoder pseudo-noise sequence (WATS) on a carrier frequency (f_{ci});

- notch filtering (WATSEF) a current frame of said audio signal at frequency band positions which are arranged in a pre-defined pattern across the sequence of frames of 10 said audio signal and inserting (WATSEF) at this frequency band position or at each of these frequency band positions, respectively, in said current frame of said audio signal said carrier frequency or one of said carrier frequencies, respectively,

15 wherein said pattern is arranged such that in the frame following said current frame no watermark signal carrier is transmitted in the frequency band or bands which have been occupied in said current frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio signal;

- transmitting or transferring (TRM) data of said current audio signal frame carrying said watermark data bits.

3. Method for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ-1...N) and said modulated encoder pseudo-noise sequence (WATS) was modulated (FCMOD) on a carrier frequency (f_{ci}),

25 and wherein at one or more different frequency band positions in a current frame of said audio signal the audio signal was notch filtered and one of said carrier frequencies was inserted instead,

30 and wherein a current audio signal frame carrying said watermark data bits was transmitted or transferred together with information about the locations of the fre-

quency band positions used for said carrier frequencies in a frame following said current frame of said audio signal,

5 wherein, in the frame following said following frame, no watermark signal carrier was transmitted in the frequency band or bands which were occupied in said following frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio signal, said method including the steps:

- 10 - receiving (REC, SYNC) and synchronising said transmitted or transferred audio signal;
- demodulating (BFDEMOD) for a current audio signal frame said carrier frequency or said carrier frequencies, respectively, thereby using said information about the location or locations of the frequency band position or positions used for said carrier frequency or frequencies, respectively, which information was attached to the data for a previous frame of said audio signal;
- 15 - convolving (DRECMF) said current frame of data of said audio signal with a time-inversed version (DECPNSEQ_1...N) of the encoder pseudo-noise sequence;
- determining (DRECMF) from the sign of the peak or the peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).

- 25 4. Method for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ-1...N) and said modulated encoder pseudo-noise sequence (WATS) was modulated (FCMOD) on a carrier frequency (f_{ci}), and wherein at one or more different frequency band positions in a current frame of said audio signal the audio signal was notch filtered and one of said carrier frequencies was inserted instead, whereby said frequency band positions were arranged in a pre-defined pattern

across the sequence of frames of said audio signal,
wherein said pattern was arranged such that in the frame
following said current frame no watermark signal carrier
was transmitted in the frequency band or bands which were
5 occupied in said current frame, in order to decrease wa-
termark data bit errors caused by echoes following recep-
tion of said audio signal, said method including the
steps:

- receiving (REC, SYNC) and synchronising said transmitted
10 or transferred audio signal;
- demodulating (BFDEMOD) for a current audio signal frame
said carrier frequency or said carrier frequencies, re-
spectively, thereby using the information about said pre-
defined pattern;
- 15 - convolving (DRECMF) said current frame of data of said
audio signal with a time-inversed version
(DECPNSEQ_1...N) of the encoder pseudo-noise sequence;
- determining (DRECMF) from the sign of the peak or the
peaks of the corresponding convolution result the value
20 of a bit of said watermark data (OWATD).

5. Apparatus for transmitting watermark data bits (IWATD)
using a spread spectrum, said apparatus including:

- means (BVMOD) for modulating said watermark data bits on
25 an encoder pseudo-noise sequence (ENCPNSEQ);
- means (FCMOD) for modulating said modulated encoder
pseudo-noise sequence (WATS) on a carrier frequency
(fci);
- means (WATSEF) for determining whether at one or more
30 different candidate frequency band positions in a current
frame of said audio signal the energy or amplitude level
of said audio signal is such that it can mask one or
more, respectively, of said modulated carrier frequencies
(fci) and which means (WATSEF), if this is true, notch
35 filter said audio signal at the corresponding frequency
band positions and insert at this frequency or at each of

these frequencies, respectively, said carrier frequency or one of said carrier frequencies, respectively, and which means (WATSEF) check at which candidate frequency band positions in a frame following said current frame of said audio signal the energy or amplitude level of said audio signal is such that it can mask one or more, respectively, of said modulated carrier frequencies (f_{ci}), and provide information about the locations of these frequency band positions;

10 - means (TRM) for transmitting or transferring data of said current audio signal frame carrying said watermark data bits together with the information about the locations of the frequency band positions to be used in said frame following said current frame of said audio signal,

15 wherein, in the frame following said following frame, no watermark signal carrier is transmitted in the frequency band or bands which have been occupied in said current frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio sig-

20 nal.

6. Apparatus for transmitting watermark data bits (IWATD) using a spread spectrum, said apparatus including:
- means (BVMOD) for modulating said watermark data bits on an encoder pseudo-noise sequence (ENCPNSEQ);
- 25 - means (FCMOD) for modulating said modulated encoder pseudo-noise sequence (WATS) on a carrier frequency (f_{ci});
- means (WATSEF) for notch filtering a current frame of said audio signal at frequency band positions which are arranged in a pre-defined pattern across the sequence of frames of said audio signal, which means (WATSEF) insert at this frequency band position or at each of these frequency band positions, respectively, in said current frame of said audio signal said carrier frequency or one 30 of said carrier frequencies, respectively,
- 35

wherein said pattern is arranged such that in the frame following said current frame no watermark signal carrier is transmitted in the frequency band or bands which have been occupied in said current frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio signal;

- means (TRM) for transmitting or transferring data of said current audio signal frame carrying said watermark data bits.

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7. Apparatus for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ-1...N) and said modulated encoder pseudo-noise sequence (WATS) was modulated (FCMOD) on a carrier frequency (f_{ci}),

20

and wherein at one or more different frequency band positions in a current frame of said audio signal the audio signal was notch filtered and one of said carrier frequencies was inserted instead,

25

and wherein a current audio signal frame carrying said watermark data bits was transmitted or transferred together with information about the locations of the frequency band positions used for said carrier frequencies in a frame following said current frame of said audio signal,

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wherein, in the frame following said following frame, no watermark signal carrier was transmitted in the frequency band or bands which were occupied in said following frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio signal, said apparatus including:

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- means (REC, SYNC) for receiving and synchronising said transmitted or transferred audio signal;
- means (BFDEMOD) for demodulating for a current audio sig-

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- nal frame said carrier frequency (f_{ci}) or said carrier frequencies, respectively, thereby using said information about the location or locations of the frequency band position or positions used for said carrier frequency or frequencies, respectively, which information was attached to the data for a previous frame of said audio signal;
- means (DRECMF) for convolving said current frame of data of said audio signal with a time-inversed version (DECPNSEQ_1...N) of the encoder pseudo-noise sequence, which means (DRECMF) determine from the sign of the peak or the peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).
8. Apparatus for regaining watermark data bits (IWATD) embedded in a spread spectrum, whereby the corresponding original watermark data bits were modulated (BVMOD) at encoder side on an encoder pseudo-noise sequence (ENCPNSEQ-1...N) and said modulated encoder pseudo-noise sequence (WATS) was modulated (FCMOD) on a carrier frequency (f_{ci}),
and wherein at one or more different frequency band positions in a current frame of said audio signal the audio signal was notch filtered and one of said carrier frequencies was inserted instead, whereby said frequency band positions were arranged in a pre-defined pattern across the sequence of frames of said audio signal, wherein said pattern was arranged such that in the frame following said current frame no watermark signal carrier was transmitted in the frequency band or bands which were occupied in said current frame, in order to decrease watermark data bit errors caused by echoes following reception of said audio signal, said apparatus including:
- means (REC, SYNC) for receiving and synchronising said transmitted or transferred audio signal;
- means (BFDEMOD) for demodulating for a current audio signal frame said carrier frequency (f_{ci}) or said carrier

- frequencies, respectively, thereby using the information about said pre-defined pattern;
- means (DRECMF) for convolving said current frame of data of said audio signal with a time-inversed version (DECPNSEQ_1...N) of the encoder pseudo-noise sequence, which means (DRECMF) determine from the sign of the peak or the peaks of the corresponding convolution result the value of a bit of said watermark data (OWATD).
- 10 9. Method according to claim 1 or 2 or apparatus according to claim 5 or 6, wherein the power or amplitude level of said modulated carrier frequency or frequencies (f_{ci}) is made such that it is masked by the energy or amplitude level of said audio signal at the corresponding frequency
15 or frequencies, respectively.